

Claims

1. A tunnel barrier for controlling the movement of an electron through a thermoelectric material comprising a potential barrier having an indented or protruded cross-section.
- 5 2. The tunnel barrier of claim 1 wherein the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section is chosen to set a threshold energy value above which the barrier is transparent to electron flow, and below which electron flow is prevented
- 10 3. The tunnel barrier of claim 1 wherein the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section is given by the relationship  $\lambda(1+2n)/4$ , where  $\lambda$  is the de Broglie wavelength of said electron, and where  $n$  is 0 or a positive integer.
- 15 4. The tunnel barrier of claim 3 in which  $n$  is an integer having a value between 0 and 4.
5. The tunnel barrier of claim 1 wherein the width of indents in said indented cross-section or the width of protrusions in said protruded cross-section the width is much more than  $\lambda$ , where  $\lambda$  is the de Broglie wavelength.
- 20 6. The tunnel barrier of claim 1 in which said potential barrier comprises an electrical insulator.
7. A thermoelectric device comprising:
  - a) a first thermoelectric material;
  - 25 b) a second thermoelectric material;
  - c) the tunnel barrier of claim 1.
8. The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with the anode of said n-type material and the cathode of said p-type material.
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9. The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material in electrical contact with said n-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with the anode of said p-type material.
10. The thermoelectric device of claim 7 wherein said first thermoelectric material comprises an n-type material, said second thermoelectric material comprises a p-type material, and wherein a tunnel barrier of claim 1 is in electrical contact with the anode of said n-type material and a further tunnel barrier of claim 1 is in electrical contact with the anode of said p-type material.
11. A method for making the thermoelectric device of claim 7 comprising:
- (a) forming an indented or protruded structure on a surface of a first thermoelectric material;
  - (b) forming an insulating material over said indented or protruded surface;
  - (c) attaching a second thermoelectric material to said insulating material.
12. The method of claim 11 in which said step of forming an insulating material comprises depositing said insulating material.
13. The method of claim 11 in which said step of forming an insulating material comprises oxidising said first material.
14. The method of claim 11 in which said step of forming an indented or protruded structure comprises etching.
15. The method of claim 11 in which said step of forming an indented or protruded structure comprises ablation.